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# RECORD OF DECISION DECLARATION

118155

SUPERFUND RECORDS  
04-00

#118155  
Site: Syntex Facility  
ID #: MO0007452154  
Break: 5.3  
Other: 4.29.98

## SITE NAME AND LOCATION

o Syntex Agribusiness, Inc., Verona, Missouri

## STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Syntex Agribusiness site in Verona, Missouri. This final plan has been developed in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Contingency Plan. This decision is based on the administrative record for this site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action is based.

## DESCRIPTION OF THE SELECTED REMEDY

This remedial action represents the final action for dioxin-contaminated soils and equipment at the Syntex Agribusiness site. This remedial action addresses the principal threats at the site by excavation and thermal treatment of soils which exceed the 20 ppb action level established for the protection of public health and the environment at commercial facilities. Thermal treatment results in the destruction of dioxin, permanently removing the contamination from the environment. A vegetative cover will be maintained over surface soils containing levels of dioxin from 1 to 20 ppb.

The major components of the selected remedial action include:

- o Excavation of all dioxin-contaminated soils exceeding the 20 ppb action level.
- o Dismantle, as appropriate, and clean contaminated equipment with a series of solvent and aqueous rinses.
- o Thermal treatment of soils and cleaning solutions excavated and removed from the site.
- o Maintain vegetative cover over surface soils containing greater than 1 ppb dioxin.
- o Install a vegetative clay cap over the Trench Area and a gravel drainage-interception trench upgradient of the Trench Area.

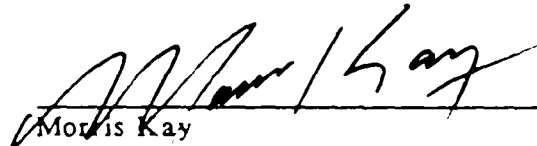
## DECLARATION

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to this remedial action and is cost-effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility or volume as a principal element and utilizes permanent solutions and alternative treatment (or

resource recovery) technologies to the maximum extent practicable. The remedy under this operable unit only addresses dioxin-contaminated soils and equipment. A five year review will be conducted at the Trench Area because contamination will remain above the health-based criteria. This review will serve to assure effectiveness of the remedy in the Trench Area. A second operable unit will be prepared if necessary to address remediation of the groundwater, Spring River and the Trench Area at the site.

5.5.88

Date

A handwritten signature in dark ink, appearing to read "Morris Kay", is written over a horizontal line.

Morris Kay  
Regional Administrator  
Region VII

**RECORD OF DECISION**  
**FOR**  
**FINAL MANAGEMENT OF DIOXIN CONTAMINATED**  
**SOIL AND EQUIPMENT AT**  
**SYNTEX AGRIBUSINESS, INC.**  
**VERONA, MISSOURI**

**Prepared by:**  
**U.S. ENVIRONMENTAL PROTECTION AGENCY**

**April 29, 1988**

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## 1.0 INTRODUCTION

### 1.1 BACKGROUND

The facility, now owned by Syntex Agribusiness Inc. is located in extreme southwestern Missouri in the town of Verona. Verona (population 500) is approximately 30 miles southwest of Springfield, Missouri.

The Spring River, which arises about three miles south of Verona, flows northward along the western outskirts of Verona. The Syntex facility is located west of Verona and occupies about 180 acres primarily along the east bank of the Spring River. The majority of the active portion of the facility is located within the 100-year floodplain of the Spring River.

The facility was used to manufacture hexachlorophene from 1970 to 1971. The manufacturing process resulted in the by-product production of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), often referred to simply as dioxin. Dioxin, trichlorophenol (TCP), and hexachlorophene have been listed as hazardous wastes under the Resource Conservation and Recovery Act (RCRA) and hazardous substances under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The past operation of a leased production building at the Verona facility has resulted in several areas of known or suspected dioxin contamination. The major subsite areas of known or suspected contamination addressed in this plan are the: Lagoon Area; Slough Area; Spill Area/Irrigation Area; Trench Area; and Burn Area.

### 1.2 SITE HISTORY

The environmental concerns at the Verona facility, began about 1960 when the facility was owned and operated by Hoffman-Taff, Inc. Hoffman-Taff produced 2,4,5-trichlorophenoxy-acetic acid (2,4,5-T) for the U.S. Army as part of the production of the defoliant commonly known as Agent Orange.

In 1969, Syntex Agribusiness, Inc., purchased the Verona facility from Hoffman-Taff. Northeast Pharmaceutical and Chemical Company (NEPACCO) had previously entered into a lease agreement with Hoffman-Taff, which was continued after the purchase by Syntex.

The production of 2,4,5-T and hexachlorophene involves the intermediate production of 2,4,5-trichlorophenol (TCP) and subsequently the potential formation of dioxin, (2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD). However, these "contaminants" were removed from the pharmaceutical grade hexachlorophene, thus creating waste streams containing TCP and dioxin. The production of hexachlorophene was discontinued in 1972 when the FDA placed restrictions on the use of hexachlorophene and the market collapsed.

### 1.3 PREVIOUS STUDIES

Numerous studies at the Verona facility date as far back as 1971. Several of the studies involved off-site locations that were suspected of being related to the facility.

The following is a brief chronology of the various investigations related to the Syntex, Verona site.

- 1971 Missouri Geological Survey and Water Resources conducted dye test to determine migratory paths leading from site. Missouri Conservation Department sampled Spring River 1.5 miles downstream of Syntex.
- 1978 EPA collected water, sediment and fish samples at and 3 miles downstream from Syntex.
- 1981 Fish and sediment samples were taken from Spring River.
- 1982 Fish and sediment samples were collected from Spring River.  
  
Trench perimeter and boring soil samples were collected by Syntex. Additional soil sampling was conducted in the burn, irrigation and old lagoon subsite areas by Syntex under EPA oversight.  
  
Consent Order between EPA and Syntex, see Section 1.5.
- 1983 Fish and sediment samples were collected from Spring River by EPA and MDNR.  
  
Consent Agreement between EPA and Syntex, see Section 1.5.
- 1984 Fish and sediment samples were collected from Spring River by EPA and MDNR.
- 1985 Syntex collected soil samples under EPA oversight. Groundwater samples were collected from wells on the facility property. Fish and sediment samples were collected from stations on the Spring River.
- 1986 Groundwater samples were collected from wells on the facility property. Fish and sediment samples taken from Spring River.
- 1987 Fish samples were collected from the Spring River.
- 1988 Sediment samples were collected from the Spring River.

#### 1.4 SUMMARY OF INVESTIGATIONS AT THE SYNTEX, VERONA SITE

The numerous investigations at the Syntex, Verona site have found contamination both on and off site which may be related to the former activities at the site. The following text summarizes these findings.

##### 1.4.1 Soil

The soil sampling efforts at the Syntex facility have identified several areas or subsites significantly contaminated with dioxin. These subsites are delineated on Figure 1.1. Most of the contaminated areas or subsites are, or have been

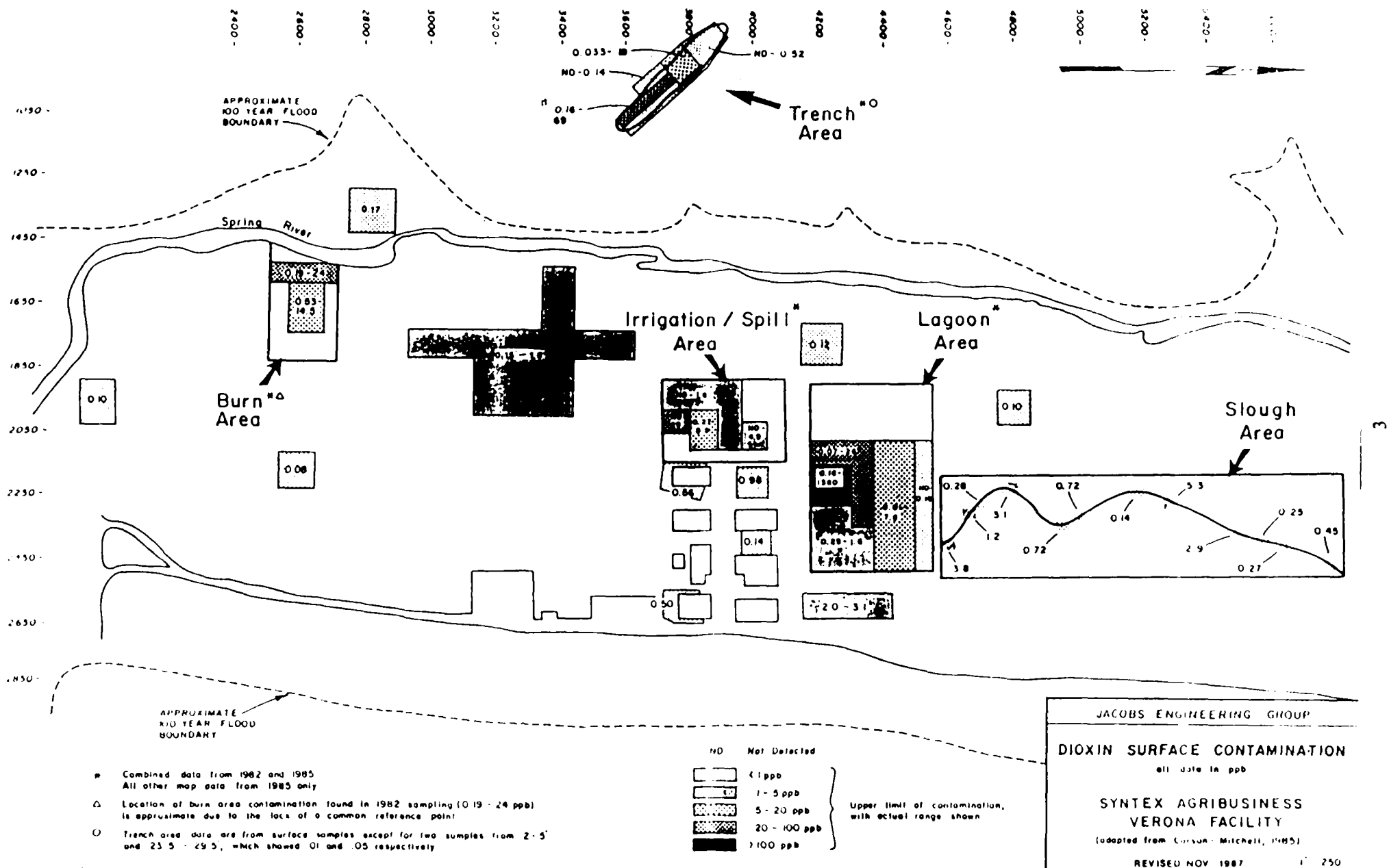


Figure 1.1



associated with specific plant activities. These subsite areas are labeled as the: Slough Area; Lagoon Area; Spill Area/Irrigation Area; Burn Area; and Trench Area.

In addition, several areas scattered across the plant site were investigated for fugitive contamination. The "Grid" Area is used as the general description for the overall site grounds sampling efforts. The dioxin contaminant levels in these areas generally are less than 1 ppb, with the exception of one area directly east of the Lagoon Area which has 3 ppb dioxin.

The highest concentrations of dioxin occur in the Lagoon Area, with dioxin levels as high as 1380 ppb. Maximum dioxin concentrations in other subsite areas are the Trench Area 67 ppb, the Burn Area 27 ppb, the Irrigation Area 29 ppb, Spill Area 4.9 ppb and the Slough Area 5.3 ppb. The remainder of the site showed little or no dioxin contamination as revealed during the "Grid" Area sampling effort.

Other organic and inorganic compounds, in addition to the dioxin contamination, were identified on the Syntex, Verona site. These are summarized in Table 1.1. As is discussed in Section 1.6 and 3.1 the Agency for Toxic Substances and Disease Registry (ATSDR) has determined that the concentration of these compounds is below the level of concern for human health.

#### 1.4.2 Groundwater

Groundwater samples collected at the Syntex facility have shown no dioxin in the groundwater. However, several other compounds have been identified in the groundwater. The maximum concentration of the compounds detected in the groundwater are presented in Table 1.2

#### 1.4.3 Fish and Sediment

The fish and sediment sampling program required by the Consent Agreement and Order signed by EPA and Syntex on September 6, 1983 and discussed in Section 1.5, has resulted in regular analyses of Spring River fish and sediment to determine the level of dioxin contamination. Analyses indicated a maximum level of 52 ppt dioxin (TCDD) in whole fish in 1981 and a lower level of 17 ppt dioxin (TCDD) in 1986. Analysis of fish fillets (edible portion) indicate a maximum level of 40 ppt in 1982 and a lower level of 2.5 ppt in 1986, 0.3 miles downstream of the site. The Food and Drug Administration (FDA) advisory level for edible portions is 25 ppt for reduced consumption and 50 ppt for no consumption. Spring River sediment samples revealed dioxin concentrations of 12 ppt in 1981, 1.6 ppt in 1984 and 6.4 ppt in 1987, 0.3 miles downstream of the site. All other sediment samples collected from the period 1981 through 1987 at stations 0.3 miles, 6.0 miles and 12.0 miles downstream revealed nondetectable levels of dioxin. Table 1.3 presents a summary of these analyses.

### 1.5 ENFORCEMENT HISTORY

A Consent Order was signed between Syntex and EPA pursuant to Section 3013 of RCRA 42, USC 6927 on August 6, 1982. The agreement provided for "...monitoring, testing, analyses, and reporting regarding the disposal areas on the Facility."

TABLE 1.1

## SYNTEX

Summary of Maximum Concentration of Non-Dioxin Contaminants  
1982, 1984 and 1985 Data  
All Concentrations in ppm

Compound	Lagoon Soil	Irrigation Soil	Trench Soil	Trench Water	Other*
1,2,4,5- tetrachlorobenzene	.465	.238	.0796	-	.0097
1,2,4- trichlorobenzene	46.40	-	3.670	.380	-
1,2,4- trimethylbenzene	-	-	-	43.20	-
1,2-dichlorobenzene	.590	-	-	-	-
1,3-dichlorobenzene	M	-	-	-	-
1,4-dichlorobenzene	1.170	-	20.20	.290	-
1-chlorodecane	-	-	.330	-	-
2,4,5- trichlorophenol	244.0	1.260	20.70	5.70	.0582 <sup>A</sup>
2,4,6- trichlorophenol	134.0	-	.890	.120	-
2,4-dichlorophenol	.830	-	.890	-	-
2-methylphenol	-	-	6.440	-	-
2-methylnaphthalene	-	3.750	1,400.0	47.0	-
4-methylphenol	-	-	4.980	1.0	-
Acenaphthene	-	-	3.250	-	-
Acetone	.550	-	-	-	-
Anthracene	-	-	27.60	-	-
Aroclor 1232	.240	-	-	-	-
Aroclor 1242	-	-	11.30	-	-
Aroclor 1248	2.70	-	-	-	-
Aroclor 1254	.297	-	.580	-	-
Benzo (B) fluoranthene	M	-	-	-	-
Benzo (K) fluoranthene	M	-	-	-	-
Benzoic acid	M	-	11.10	-	-
Benzyl alcohol	.015	-	-	-	-
Bis (2-ethylhexyl) phthalate	1.730	-	5.410	.160	-
Butyl benzyl phthalate	1.60	-	-	-	-
Chlorobenzene	.105	-	.0089	-	-
Chrysene	M	-	-	-	-
Di-n-butyl phthalate	-	-	M	1.40	-
Di-n-octyl phthalate	M	-	-	-	-
Dibenzofuran	-	-	1.110	1.60	-
Ethylbenzene	.0068	-	.033	-	-
Fluoranthene	M	-	-	-	-
Fluorene	-	-	58.0	2.30	-
Fluorotrichloromethane	-	-	.0085	-	-
Hexachlorophene	170.0	13.80	3.490	-	3.740 <sup>B</sup>
Methylene chloride	.790	.250	.094	-	-
Naphthalene	.490	1.390	355.0	13.0	-
o-Xylene	.039	-	200.0	-	-
Phenanthrene	1.50	.780	120.0	5.50	-
Phenol	-	-	3.670	1.800	-
Pyrene	M	-	-	-	-
Toluene	1.220	-	.30	-	-
Tridecane	-	-	32.0	-	-

\* - General area outside of the smaller, individually  
sampled areas (lagoon, irrigation, and trench areas)

A Concentrations as high as 1,540 have been found at a depth of 3-4.5 feet.

B Concentrations as high as 46,200 have been found at a depth of 3-4.5 feet.

M Compounds identified but not quantified.

TABLE 1.2

Maximum Concentrations of Tentatively  
Identified Compounds in Groundwater  
(ppm)  
1985 and 1986 Data

1,1,1-trichloroethane	.047
1,1,2,2-tetrachloroethane	.320
1,1-oxybisbenzene	.120
1,2,3-trimethylbenzene	.023
1,2,4-trimethylbenzene	.005
1,2-dichlorocyclohexane	.047
1,2-dimethylbenzene	.156
1,3-dimethylbenzene	.111
1,3-dinitrate-1,2,3-propanetriol	.784
1,4-dichlorobenzene	.058
2,2-bi-1,3-dioxolane	.045
2,2-dimethyl-1,3-propanediol	.036
2,2-thiobisethanol	.726
2,5-dimethyl tetrahydrofuran	.012
2-methyl-3-(1-methylethyl) oxirane	.058
3,5,5-trimethyl-1-hexene	.001
3-chlorophenol	.151
4-chlorophenol	.110
4-fluoro-1,1-biphenyl	.050
5-methyl-1-hexene	.047
5-methyl-1-hexyne	.046
6-nitro-2-picoline	.148
Benzeneacetic acid	.031
Bromocyclohexane	.002
Chlorobenzene	.048
Dimethylbenzene	.046
Ethylbenzene	.041
Hexanedioic acid, dioctyl ester	.386
Hexanoic acid	.327
Methylbenzene	.090
Methylene chloride	.047
Methylguanidine	.842
N-n-dimethylformamide	.265
Pentanoic acid	.061
Tetrahydro-2H-pyran-2-methanol	.038
Trans-4-chlorocyclohexanol	.014
Trichloroethane	.004

TABLE 1.3

## FISH (SUCKER TYPE) AND SEDIMENT SAMPLES TAKEN FROM THE SPRING RIVER

## SEDIMENT SAMPLES (ppt)

Location .....	1981 .....	1983 .....	1984 .....	1985 .....	1986 .....	1987 .....
Loc No. 1 0.3 Miles Downstream	12	ND (27)	1.6	ND (3.0)	ND (7.5)	6.4
Loc No. 3 6.0 Miles Downstream	ND(10)	ND(9)	ND (1.5)	ND (2.3)	ND (2.6)	ND (0.8)
Loc No. 5 12.0 Miles Downstream	-	-	ND (1.2)	ND (2.5)	ND (9.1)	ND (0.8)

## FISH SAMPLES (ppt)

	Sample Type .....	1981 .....	1982 .....	1983 .....	1984 .....	1985 .....	1986 .....	1987 .....
Location No. 1 0.3 Miles Downstream	Whole fish fillet	52 -	- 40	28 20	26 4	14 3.0	8.5 2.5	21.3 4.8
Location No. 2 3.0 Miles Downstream	Whole fish fillet	39 -	- -	- -	22-34 4	11 3.0	16.9 4.4	13.4 3.4
Location No. 3 6.0 Miles Downstream	Whole fish fillet	- -	- -	- -	12 3	6.0 ND	6.2 1.3	7.0 1.8
Location No. 4 9.0 Miles Downstream	Whole fish fillet	- -	- -	- -	11 2	5.4 1	6.9 1.7	8.3 1.3
Location No. 5 12.0 Miles Downstream	Whole fish fillet	- -	- -	- -	3 ND	ND ND	1.8 1.2	1.7 0.3

- data not available

ND None Detected

( ) Detection Limit

The 1981 and 1983 data was generated by the U.S. EPA.

The 1982 data was generated by Dr. Gross of the University of Nebraska-Lincoln

The 1984 and 1985 data was generated in compliance with the Fish and Sediment Plan and the analyses were performed by Dr. Gross at the University of Nebraska-Lincoln.

The 1986 and 1987 data was generated in compliance with the Fish and Sediment and the analyses were performed at Syntex Research Laboratory in Palo Alto, CA.

A second Consent Agreement and Order between Syntex and EPA was signed September 6, 1983 pursuant to Section 106 of CERCLA, 42 USC 9607 and Section 3013 of RCRA. The order required the following actions:

- o posting of warning signs around specified disposal areas;
- o development and submittal of a Sampling and Analysis Plan for defining the extent and nature of dioxin contamination;
- o implementation of Sampling and Analysis Plan upon approval by EPA;
- o development and submittal of a Fish and Sediment Sampling Plan for the dioxin contamination in the Spring River;
- o implementation of a Fish and Sediment Sampling Plan upon approval by EPA;
- o preparation and submittal of a Remedial Alternatives Report based on the results of Sampling and Analysis Plan;
- o preparation and submittal of an implementation plan which will include plans and specifications for the preferred remedial alternative, schedule for implementation and reporting, description of the necessary reports and safety plans.

This Consent and Agreement Order is currently being carried out by Syntex.

The site has been placed on the National Priority List of Hazardous Waste Sites. In addition the site is included on the State of Missouri Registry of Abandoned or Uncontrolled Hazardous Waste Disposal Sites pursuant to the Missouri regulation found at 10 CSR 25-10.010.

## 1.6 PUBLIC PARTICIPATION

Public participation in the process of selecting the final remedy at other Southwest Missouri dioxin sites began in May 1984 when the EPA announced plans to set up an incinerator system at the Denney Farm site. Public hearings were held by the EPA and the Missouri Department of Natural Resources (MDNR) in September 1984 regarding the permit for the incinerator system. The incinerator arrived at the Denney Farm on December 15, 1984 and between February and April 1985 conducted four trial burns. These trial burns successfully and safely removed and destroyed the dioxin contained in the contaminated materials. On July 18, 1985 the incinerator began burning a variety of dioxin-contaminated soils and liquids. Phase I operations were completed on September 19, 1987 with materials from Denney Farm, Erwin Farm, Talley Farm, Rusha Farm and Neosho Wastewater Treatment School being successfully treated. In March 1987 the EPA and MDNR held a public meeting to discuss extending the permit for incinerator operation at Denney Farm. The new permit allowed the EPA to operate the incinerator through May 1989 as part of Phase II. Proposed activities under Phase II include burning dioxin-contaminated material from additional southwest Missouri sites, i.e. Baldwin Park in Aurora, the Syntex, Springfield facility, and the Syntex, Verona facility.

Public participation in the selection of a final remedial action for the Syntex Agribusiness site in Verona, Missouri began with the public release of the Syntex "Remedial Alternatives Report," the EPA "Proposed Plan for Final Management of Dioxin Contaminated Soil and Equipment, Syntex, Verona" and Administrative Record on March 21, 1988. The Syntex Report evaluated remedial alternatives for the dioxin-contaminated soil and equipment and presented general plans for future monitoring of the local groundwaters. The EPA Proposed Plan recommended excavation and treatment of dioxin-contaminated soils and equipment above an action level of 20 ppb dioxin for surface soils and

maintenance of a vegetative cover over soils containing between 1 ppb and 20 ppb dioxin. Installation of a vegetated soil cap and gravel drainage-interception trench was proposed for the Trench Area.

A public comment period was held from March 21, 1988 through April 22, 1988 for the Syntex Remedial Alternatives Report and EPA Proposed Plan. A public meeting was held on March 29, 1988 to discuss the Syntex Remedial Alternatives Report and the EPA Proposed Plan.

All documents used in selection of the remedy are included in the Administrative Record. The Record of Decision and Responsiveness Summary will also be included in the Administrative Record which is available for review at a local repository in Verona, Missouri and the U.S. EPA Region VII office in Kansas City, Kansas.

## 1.7 SUMMARY OF SITE RISKS

### 1.7.1 Contaminants of Concern

The primary contaminant of concern at the site is 2,3,7,8 TCDD, commonly referred to as dioxin. Dioxin is considered one of the most toxic compounds known, with the LD-50 (lethal dose to 50 percent of tested populations) level for male guinea pigs, the most sensitive species, being 0.6 ug/kg.

Although dioxin has been highly toxic in all species tested, there are large species differences in sensitivity, with the LD-50 for hamsters being 1,157 to 5,051 ug/kg. The characteristic signs and symptoms of lethal dioxin poisoning are severe weight loss and thymic (immune system) atrophy. Death in laboratory animals usually occurs many days after exposure. After subchronic or chronic exposure to dioxin in rats or mice, the liver appears to be the most severely affected organ, although systemic hemorrhage, edema (excess fluid accumulation), and suppressed thymic activity are also observed.

Animal studies have also demonstrated that dioxin is teratogenic (causes malformities) and fetotoxic (toxic to fetus) in mice, rats, rabbits, monkeys and ferrets and is fetotoxic in monkeys. Also, since dioxin produced statistically significant increased incidents of tumors in two animal species, there is sufficient evidence to conclude that dioxin is an animal carcinogen. In fact, dioxin is the most potent animal carcinogen evaluated to date by the EPA Carcinogen Assessment Group. For comparison, dioxin is about 50 times as potent as the third most potent animal carcinogen evaluated (bis-chloromethyl ether) and about 50 million times more potent than vinyl chloride (a widely known carcinogenic substance).

Study results concerning humans that have been exposed to herbicides and other chlorinated chemicals containing dioxin as a contaminant indicate that excessive exposure leads to altered liver function and lipid metabolism, and neurotoxicity. In addition, humans may develop skin lesions, chloracne and hyperpigmentation.

The available epidemiologic evidence concerning the carcinogenicity of dioxin in humans is inadequate. Considering the available animal carcinogenic and epidemiologic data, however, the overall weight-of-evidence classification for dioxin (using EPA's interim classification scheme) is category B2, a probable human carcinogen.

Polychlorinated dibenzo-p-dioxins are a class of chlorinated tricyclic aromatic hydrocarbons consisting of two benzene rings connected by a pair of oxygen atoms. According to the position and number of chlorine atoms, it is possible to form 75 different types of chlorinated dioxins. The word "dioxins" is often used to refer to this class of compounds, especially with respect to the highly toxic 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) that is present at Syntex, Verona. This class of compounds is rather stable in the presence of heat, acids, and alkalis. They are also chemically stable and start to decompose only at temperatures greater than 500 degrees Celsius; the percent of decomposition depends upon the residence time at high temperature and the proportion of oxygen in the heated zone.

Physico-chemical properties suggest that dioxin will adsorb tightly to organic material in soil, resulting in low mobility. Once in the soil, degradation processes tend to be very slow, with half lives estimated to be ten years or longer.

Calculated and experimental results show that dioxin will concentrate in biota present in aquatic media. Reported bioconcentration factors of dioxin in fish range from about 2,000 to 30,000. In mammals, dioxin is readily absorbed through the gastrointestinal tract. Absorption through intact skin has also been reported. Absorption may decrease dramatically if dioxin is adsorbed to particulate matter such as activated carbon or soil. After absorption, dioxin is distributed to tissues high in lipid (fat) content; however, in many species the liver is a major storage location. Metabolism of dioxin occurs slowly, with metabolized dioxin excreted in the urine and feces. Unmetabolized dioxin can be eliminated in the feces and in the milk.

#### 1.7.2 Risks to Human Health and the Environment

Continued long-term direct contact with or ingestion of soils would present the greatest threat to human health. This exposure potential for humans can be limited by controlling site access. Ingestion of dioxin could occur if fish containing levels of dioxin from the Spring River were consumed or by direct ingestion of Syntex, Verona plant soils. Wildlife (deer, turkey, rabbit) in the slough area would be susceptible to contamination, as historically there were no controls on animal access in this subsite area.

Inhalation of dioxin-contaminated airborne particulates presents a potential route of human exposure. The principal concern for inhalation of contaminated particulates would be for Syntex, Verona employees and onsite workers during periods of onsite construction activities involving disturbance of contaminated soils. Mitigative measures exist to control this risk.

Ingestion of plants grown in contaminated soil represents a potential exposure route, although there is uncertainty regarding the potential for uptake of dioxin in plant life. Dioxin uptake in many plants appears to be minimal. This potential pathway would be limited by controlling site access. Land use restrictions represent another effective means of controlling this exposure potential, although potential uptake in plants would be unaffected.

The most significant environmental problem which could be expected at Syntex, Verona is the transport of dioxin to the Spring River due to erosion of surficial soils. A limited potential exists for surface contamination to reach the river by transport during rainfall events, particularly during periods of flooding at the

plant site which lies in the floodplain of Spring River. The potential for suspended contaminated sediment to reach the Spring River during normal flow conditions is much lower. Stormwater is normally retained on site until it is absorbed into the ground.

The threat to human health and the environment due to bioaccumulation in fish as a result of the release of dioxin from the Syntex, Verona site appears to be decreasing. Although fish in the Spring River have shown detectable levels of dioxin, contaminant levels have consistently been below the advisory level of 50 ppt designated by the Food and Drug Administration since 1982.

### 1.7.3 Risk Assessment

A paper was published in 1984 by Renate D. Kimbrough, M.D., et al., of the Center for Environmental Health, Centers for Disease Control, which evaluated acceptable soil concentrations of dioxin in residential settings. A risk assessment was performed in this paper on the basis of several chronic feeding studies in rodents. The smallest lower confidence bound corresponding to a  $1 \times 10^{-6}$  incremental cancer risk was calculated to be 28 femtograms ( $10^{-15}$ ) per kilogram body weight per day (fg/kg b.w./day). This calculation was based on data for hepatocellular carcinoma (liver cancer) and neoplastic nodules. This means that a lifetime average dosage of 28 fg/kg b.w./day would be expected to result in one additional case of this particular type of cancer for each million individuals so exposed. This number is based upon a number of conservative assumptions, as discussed in the 1984 paper. Cancer in other types of body tissues would occur at higher dosages. On the basis of data for tissue less sensitive than the liver, the paper reported that an incremental cancer risk of  $1 \times 10^{-6}$  would be expected to occur at a lifetime dosage level of 1,428 fg/kg b.w./day.

Intake levels for residential exposure were calculated by Kimbrough, et al., for dermal (skin), ingestion and inhalation exposure pathways. In residential settings, the principal exposure pathway is through ingestion of contaminated soil. Ingestion of soil by children is of particular concern in residential areas. Small children may consume soil directly during play, although inadvertent ingestion of soil by both children and adults can also occur. The paper estimated the average lifetime daily dose resulting from exposure to 1 ppb dioxin in a residential setting to be 636.5 fg/kg b.w./day. This recommendation formed the basis for the cleanup criteria of 1 ppb dioxin which has been applied for the cleanup of residential sites.

Dioxin cleanup levels have been established for different media during cleanup of other Missouri dioxin sites. A cleanup level of 4 picograms per square meter ( $\text{pg}/\text{m}^2$ ) has been recommended for interior surfaces by CDC. The action level for dioxin in water is limited by the detection limit, which by current methods is approximately 1 ppt. A level of  $3 \text{ pg}/\text{m}^3$  representing the average of 14 data points has been used as a level of concern for airborne dioxin levels during the cleanup of other eastern Missouri dioxin sites.

The 1984 Kimbrough paper recommended that risk management decisions by EPA should be based upon a consideration of the specific circumstances and exposure opportunity at each contaminated site. The paper noted that in certain nonresidential areas, higher levels may present an acceptable degree of protection of human health. Conversely, soil levels less than 1 ppb dioxin may be of concern in areas used for certain agricultural purposes.



Potential exposure at commercial areas, in addition to being less frequent and of shorter duration, occurs through different primary pathways than in residential settings. Ingestion is the principal exposure pathway of concern in residential settings due to the potential for regular contact by small children who may consume substantial quantities of soil. In certain non-residential areas there is less opportunity for this type of regular exposure by small children to occur. In commercial or industrial settings where occupational exposure occurs, direct contact is the primary pathway of concern. The acceptable dioxin soil level is controlled in these non-residential settings by limiting the potential for such contact to occur.

The Center for Disease Control, through the Agency for Toxic Substances and Disease Registry (ATSDR) has recently provided supplemental information to the 1984 paper by Kimbrough, et al., in a series of correspondence between ATSDR and EPA which evaluates exposure to soils contaminated at levels in excess of 1 ppb in non-commercial areas. The ATSDR advisory concludes that the average lifetime daily dosage in a commercial setting contaminated at 20 ppb dioxin is 33 fg/kg b.w./day. This calculated dosage is below the average daily dose estimated to be of concern for public health in the 1984 article by Kimbrough, et al. In addition, this dosage is substantially below the estimated dosage corresponding to residential exposure to 1 ppb dioxin (636.5 fg/kg b.w./day). The Agency has therefore concluded that certain types of non-residential exposure to soil contaminated at 20 ppb dioxin is below a level of concern for public health. The Agency, in consultation with the ATSDR, has concluded that a remedial action at Syntex, Verona resulting in the removal of soils exceeding 20 ppb would reduce the risk associated with non-residential land usage to an acceptable level.

## 1.8 DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy presented in this document is identical to the remedy proposed in the EPA Proposed Plan of March 22, 1988 except for the following determination. The Agency has determined that because this remedy will not result in hazardous substances remaining at the plant site above health-based levels, the five year facility review will not apply to the action at the plant subsite areas. However, a five year review will be conducted at the Trench Area because contamination will remain above the health-based criteria. This review will serve to assure effectiveness of the remedy in the Trench Area.

## 2.0 ALTERNATIVES EVALUATED

The final evaluation of the remedial alternatives presented in the Proposed Plan were based on the subsite considered, i.e. Slough Area, Lagoon Area, Spill/Irrigation Area, Burn Area and Trench Area; subsite location; and the levels of dioxin detected. The primary remedial alternatives considered for all areas of the Syntex, Verona site which contain levels of dioxin greater than 20 ppb, were 1) In-place containment with vegetative cover and 2) Excavation and Thermal Treatment. Soil sampling, using a 95 percent confidence level sampling protocol, would be conducted prior to excavation of any area to establish the extent of surface contamination. Confirmation sampling would be conducted subsequent to excavation to verify that dioxin concentrations average less than 20 ppb. The remedial action considered for the other areas containing dioxin less than 20 ppb, was to establish and maintain vegetative covers (including topsoil as necessary). Those alternatives considered for each potentially affected subsite are briefly described in Table 2.1. A description of these remedial alternatives is provided

below.

## 2.1 NO ACTION

### ALTERNATIVE 1. MAINTAIN EXISTING CONDITIONS

The no action alternative was to leave the site conditions as they currently exist. Also, various institutional controls, (i.e. fencing and deed restrictions), were considered under this alternative.

## 2.2 STABILIZATION

### ALTERNATIVE 2. ESTABLISH AND MAINTAIN VEGETATION

This alternative consisted of seeding, mulching and fertilizing the subsite grounds. Prior to these activities, each subsite would be backfilled as necessary to raise the elevation to grade. This action was the sole remedial alternative proposed for the "Grid" Area, the Spill Area and the Slough Area.

### ALTERNATIVE 3. IN-PLACE CONTAINMENT

The options listed below (3A through 3D) were proposed for one or more of the subsites. Each option proposed to keep the dioxin-contaminated soils in place with various types of covers. The covers would be constructed to prevent significant infiltration, promote runoff and avoid ponding.

#### Alternative 3A: One-Foot Vegetative Soil Cover

Alternative 3A was proposed for several subsite areas, i.e. Irrigation Area, Burn Area, Lagoon Area. This option would be conducted as a sole remedy or subsequent to excavation activities, depending on the levels of dioxin in the soil and would be followed by actions to establish and maintain vegetation as described in Alternative 2.

#### Alternative 3B: Rock Base with Asphalt Cover

Alternative 3B was proposed for the Spill Area. This alternative included placement and grading of a 4 to 6 inch nominal stone layer over the existing rock base. A four-inch layer of asphalt would be installed and maintained over the stone base layer.

#### Alternative 3C: Clay Backfill with Six-Inch Vegetative Cover

Alternative 3C was proposed for the Slough Area. This activity involved placing clay in the Slough channel as a backfill material and grading the surface to produce a gradual swale. Six inches of topsoil would then be added to support a vegetative cover which would be established and maintained as described in Alternative 2.

TABLE 2.1  
SUMMARY OF REMEDIAL ALTERNATIVES  
Proposed Remedial Alternatives

Area	Proposed Remedial Alternatives
Grid area	Maintain vegetation.
Burn area	No Action Stabilization Establish and maintain vegetation; In-place containment with a one-foot vegetated soil cover; Removal* Excavation and thermal treatment of dioxin-contaminated soils
Spill Area	No Action Stabilization Establish and maintain vegetation; In-place containment with an asphalt cover; Deep tillage of surface soils. Removal Excavation and onsite burial of low level contaminated gravel.
Irrigation Area	No Action Stabilization Establish and maintain vegetation; In-place containment with a one foot vegetated soil cover; Deep tillage of surface soils; Removal* Excavation and thermal treatment of dioxin-contaminated soils
Trench Area	No Action Stabilization In-place containment with a one foot clay cap, one foot vegetated soil cover; Monitoring - Subsurface
Lagoon Area	No Action Stabilization In-place containment with a one foot vegetated soil cover; Deep tillage of surface soils; Removal* Excavation and thermal treatment of dioxin-contaminated soils
Slough Area	No Action Stabilization Backfill and establish vegetation cover.
Old NEPACCO Equipment	Clean, wipe, test, and determine proper disposal or reuse conditions.
Photolysis Equipment	Solvent rinse, acid rinse, water rinse, disassemble, inspect, wipe test and determine proper disposal or reuse conditions.
Groundwater	Install monitoring wells and assess data generated at plant site and in Trench Area.
Solvents and Washes	Hold solvents for eventual disposal. Treat aqueous washes to remove TCDD to less than 1 ppt before evaporation.

\*Excavation will involve those soils containing dioxin above the 20 ppb action level.

#### Alternative 3D: Gravel Backfill, Twelve-Inch Clay Cap, Twelve-Inch Vegetated Cover

Alternative 3D was proposed for the Trench Area. This activity would involve: backfilling trench depressions to the original grade with gravel aggregate to provide a stable, compacted fill; installing a 12" layer of compacted clay extending ten feet beyond the trench boundaries, sloped to facilitate run off; installing a 12" layer of topsoil over the clay layer; and reestablishing vegetation.

#### ALTERNATIVE 4. DEEP TILLAGE OF SURFACE SOILS

This alternative involved inverting the surface soil layer to bury low level surface contamination beneath one to two feet of soil. The tilled area would subsequently be revegetated. Verification sampling would be performed after tillage to confirm the absence of surface contamination.

#### 2.3 REMOVAL

##### ALTERNATIVE 5. EXCAVATE TOP SIX INCHES OF SURFACE MATERIAL, BACKFILL, ESTABLISH AND MAINTAIN VEGETATION

This alternative involved the excavation of the top six inches of cover material with a backhoe. The removed material would be disposed of onsite in other excavated areas and covered with one-foot of topsoil. The excavated area would be backfilled with topsoil to the existing grade and a vegetative cover established as described in Alternative 2. This alternative was specifically proposed for the Spill Area where six inches of gravel lie atop a section of ground contaminated with dioxin below 20 ppb.

##### ALTERNATIVE 6. EXCAVATION OF ALL SOILS CONTAMINATED WITH DIOXIN ABOVE THE 20 PPB ACTION LEVEL AND OFFSITE THERMAL TREATMENT

This alternative provided for excavation of all soils showing concentrations of dioxin above 20 ppb based on the 95 percent confidence level. The subsites potentially affected include the Burn, Irrigation and Lagoon Areas. A backhoe would be used for the excavation. Gravels from the Spill Area could be used as backfill for excavated areas greater than one foot deep.

The excavated soils and debris would be placed in a dump truck, covered and transported approximately 15 miles to the existing thermal treatment unit at the Denney Farm Site. All ash and residues would be disposed at a State approved landfill. This action was and remains contingent on the success of ongoing negotiations to obtain an access agreement with the owner of Denney Farm. If these negotiations were not successful, then contaminated soils would be excavated and stored onsite in compliance with the applicable EPA and State rules and regulations.

#### 2.4 EQUIPMENT REMEDIATION

Old equipment originating from NEPACCO's operation and equipment used in the onsite photolysis process remain onsite. An option to remediate this equipment allowing future use was proposed. However, if this equipment could not be satisfactorily cleaned then it would be disposed of according to the action

schedule provided below, under Section 2.4.1. Ultimate disposal of the solutions used in the process to clean this equipment would be in accordance with the Resource Conservation and Recovery Act (RCRA) and other applicable regulations.

#### 2.4.1 Old NEPACCO Equipment

This equipment includes: "Cleaned-Still Detectable" equipment which was previously cleaned, retested and found to be still contaminated; "Six Tanks Containing NEPACCO Residues" from processes attributed to NEPACCO operations; and "Out-of-Service" equipment which has not been cleaned. It should be noted that the residues from the "Six Tanks" have been removed, containerized and stored onsite in the Photolysis Area. The "Clean-Still Detectable" and "Six Tanks" equipment would be cleaned with an acid wash prior to detergent and solvent washes. The "Out-of-Service" equipment would be cleaned with detergent washes and wipe tested subsequent to the approved cleaning process. The following table indicates what action would be taken subsequent to equipment testing.

<u>Level of Dioxin</u>	<u>Action</u>
Less than 10 ng/m <sup>2</sup>	Possible Reuse
10-100 ng/m <sup>2</sup>	Landfill or Scrap Metal
100-1000 ng/m <sup>2</sup>	Foundry Disposal
Greater than 1000 ng/m <sup>2</sup>	Hold until proper disposal technology is developed or reclaim using alternate techniques.

Disposal of cleaning solutions would be consistent with the option proposed for disposal and destruction of contaminated soils. These solutions would either be concentrated or thermally treated immediately following the cleaning process.

#### 2.4.2 Photolysis Equipment

Proposed remediation of this equipment included a series of solvent and aqueous rinses; the first consisting of isopropanol or fuel oil, the second consisting of a mixture of phosphoric or hydrochloric acid and water followed thirdly by an acid rinse. The rinses would be initiated at the beginning of the photolysis process and would be flushed through each piece of equipment and transfer line which handled stillbottom residues. The rinses generated would be drummed for eventual disposal in an approved manner, as described under Section 2.4.1. After the rinses the equipment would be completely dismantled, inspected, recleaned as necessary and wipe tested. If the wipe test results are less than 10 ng/m<sup>2</sup> the equipment would be stored for possible use. Otherwise the equipment would be disposed of in the manner described under Section 2.4.1.

### 3.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF THE ALTERNATIVES

The alternatives described in Section 2.0 were evaluated using evaluation criteria presented in EPA Directive 9355.3-02, "Draft Guidance on Preparing Superfund Decision Documents: The Proposed Plan and Record of Decision." These criteria

relate directly to factors mandated by SARA in Section 121 and considerations which measure the overall feasibility and acceptability of the remedy. These evaluations are summarized below.

### 3.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Protection of human health and the environment is the central mandate of CERCLA, as amended by SARA. Protection is achieved by reducing risks to acceptable levels and taking action to ensure that there will be no future unacceptable risks to human health and the environment through any exposure pathway. Each remedial alternative will have different long-term and short-term effects on the protection of human health and the environment.

All the alternatives evaluated the Proposed Plan provide some degree of protection to public health and the environment. However, the degree of protection and the permanence of the protectiveness vary between the alternatives. Alternatives involving excavation of soils contaminated with greater than 20 ppb dioxin would provide a high long-term degree of protection for human health. Alternatives involving long-term management of soils left (containing less than 20 ppb) in-place would adequately protect human health and the environment and require regular monitoring, maintenance and the use of access restrictions to adequately assure the continued effectiveness of the remedy.

Concentrations of dioxin in surface soil as high as 1380 ppb have been detected at Syntex, Verona. While these levels represent a potential threat to public health, there is no indication that the environment has been impaired significantly. The primary environmental concern at Syntex, Verona is the potential migration of dioxin into the Spring River. The Syntex, Verona site is a relatively flat area, most of which is within the 100-year flood plain of the Spring River. The Trench Area is the only subsite not within the 100-year flood plain. During rain events, stormwater generally collects in the Slough Area where it drains to the Spring River or infiltrates into the ground.

Reducing surface dioxin concentrations from as high as 1380 ppb to 20 ppb or less would substantially reduce any potential for harm to the environment from contaminated soils. Maintaining existing vegetation covers over areas where dioxin concentrations are below the 20 ppb action level, would effectively minimize the potential for human contact and environmental impairment, provided the continued integrity of the vegetative cover is maintained. A cleanup level of 20 ppb dioxin has been established for all areas of the Syntex, Verona site, as no part of the site is considered to be a residential area. The Agency believes that the continued non-residential usage of the Syntex, Verona site is assured through a combination of existing contractual and statutory controls and practical considerations. For example, as the 20 ppb dioxin action level corresponds to non-residential land use at the Syntex, Verona site, federal and state health advisories do not allow residential use of the site. Furthermore, Syntex, Verona is listed on Missouri's Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites. Missouri law provides that the State must concur with a request to change the land usage of any site on this registry. By this mechanism, the State of Missouri has control over future land use at the Syntex, Verona site.

Concentrations of organic contaminants other than dioxin have been detected at the Syntex, Verona site. However, the levels of surface soil contamination for

### 3.5 LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness and permanence addresses the long-term protection and reliability an alternative affords.

In-place containment alternatives provide an acceptable degree of long-term effectiveness and reliability. However, frequent inspection and maintenance of the cap or cover would be mandatory to assure the success of this alternative. Maintenance activities including mowing, fertilizing and repair would serve to increase the effectiveness of the remedy. In addition, access restrictions would be required in order to prevent possible disturbance of the cap or cover.

Thermal treatment of excavated soils provides long-term protection and reliability. Thermal treatment results in the removal and destruction of dioxin in soil and eliminates the potential for future exposure. Following completion of thermal treatment, no residual contamination exceeding a level of concern for public health remains onsite. There are no ongoing maintenance requirements necessary to ensure the continued effectiveness of the remedy.

### 3.6 IMPLEMENTABILITY

Implementability addresses how easy or difficult, feasible or infeasible, an alternative would be to carry out from design through construction, operation and maintenance.

The implementability of the in-place containment alternatives is affected by technical considerations, such as availability of suitable cover materials (rock, clay, soil and seed for acclimated vegetation) and access to affected areas. The remedial design would take site characteristics into account - for instance, because the site is in a floodplain, it may need flood-proofing in accordance with RCRA requirements.

Implementation of thermal treatment involves relatively complex technologies. These measures have been implemented successfully during the cleanup of other Superfund sites. The time required to complete thermal treatment varies depending upon treatment capacity.

Routine maintenance and monitoring of the thermal destruction unit would ensure reliability and minimize the potential for failure. If monitoring indicates the potential for failure of the thermal destruction unit, the unit would be shut down until corrective measures are taken. Operation of thermal destruction units has shown that they are capable of successfully destroying dioxin-contaminated materials and are able to meet applicable or relevant and appropriate requirements. In addition, operation of the EPA mobile incinerator system has demonstrated that the residues from the treatment of dioxin-contaminated materials can be successfully delisted.

It should be noted that full-scale operation of transportable incineration units at hazardous waste sites has been limited. Some such units have experienced extended periods of downtime. It is possible that operation of the unit at Denney Farm would result in some extended downtime periods. The downtime periods could delay the completion of thermal destruction of contaminated soils.

### 3.7 COST

CERCLA requires that EPA select the most cost-effective (not merely the lowest cost) alternative that protects human health and the environment and meets other requirements of the law. Costs for the operable unit included in this plan will be incurred by Syntex for the duration of the remedial action including the necessary operation, maintenance and review and any additional action that may be determined to be necessary as a result of that operation, maintenance and review. Cost estimates for the proposed remedial alternatives are presented in Table 3.1.

The estimates presented do not consider the potential replacement cost for containment or disposal alternatives which may be required in the event of failure.

### 3.8 COMMUNITY ACCEPTANCE

This evaluation criteria addresses the degree to which members of the local community support the remedial alternatives being evaluated.

The local community has demonstrated favorable support for the proposed remedy. Comments received from the responding community have focused on implementation of the proposed remedy and the timeliness of the implementation process. Residents attending the public meeting indicated support for excavation and treatment of surface soils containing greater than 20 ppb dioxin and maintenance of a vegetative cover over soils containing between 1 ppb and 20 ppb dioxin.

A specific concern regarding remediation of the Slough Area was presented by the City of Verona. A gravity flow wastewater effluent line discharges to the Slough in the area proposed for remediation. It has been proposed that this discharge line be relocated in a manner that facilitates gravity flow from the wastewater treatment plant and allows filling of the Slough channel as specified in the selected remedy.

One commenter expressed concern over the 20 ppb action level and the study upon which it is based. Comments generally criticize the action level as too conservative and called the assumptions used on the quoted study as invalid. The supported action level established for the Syntex, Verona site is based upon the 1984 report entitled, "Health Implications of 2,3,7,8 Tetrachlorodibenzodioxin (TCDD) Contamination of Residential Soil," Renate D. Kimbrough, M.D., et.al., Center for Environmental Health, Centers for Disease Control (CEH/CDC). The EPA believes that the 1984 CDC report is a valid risk assessment upon which to base an action level. The CDC has recently supported the paper stating that no scientific evidence has been reported in the literature to date which would invalidate the assumptions upon which the 1984 risk assessment is based, or its conclusions.

The option of removing contaminated soils from the site and transporting the soils to and incinerating the contaminated soils at the Denney Farm site would be acceptable to the surrounding community. To date the incinerator at Denney Farm has received contaminated soils from other sites located in the vicinity. This remedial alternative, removing and transporting contaminated soils to and incinerating at the Denney Farm site, has been accepted as a preferred



**TABLE 3.1**

**ESTIMATED COST OF PROPOSED REMEDIAL ALTERNATIVE**

**1. STABILIZATION**

**A. Maintain Vegetation/In-place containment**

Grid Area	\$10,000
Slough Area	\$275,000
Trench Area	\$375,000

**2. REMOVAL**

**A. Excavate Gravel, Transport, Backfill, Vegetate**

Spill Area	\$14,000
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**B. Excavate and Incinerate Soil, Transport, Backfill, Vegetate**

Burn Area	\$453,000
Irrigation Area	\$750,000
Lagoon Area	\$2,500,000

**3. EQUIPMENT REMEDIATION**

Old NEPACCO Equipment	\$300,000
Photolysis Equipment	\$750,000
Solvents & Washes	\$190,000

alternative. Tours of the Denney Farm Incinerator facility have revealed a general positive attitude from the general public and surrounding communities.

### 3.9 STATE ACCEPTANCE

The state acceptance criteria addresses the concern and degree of support that the state government has expressed regarding the remedial alternative being evaluated.

The State of Missouri has generally supported the proposed remedy. The state has worked closely with the Agency in the planning and review process which considered the remedial alternatives for the Syntex, Verona site. The State also contributed to the process of outlining the expanded groundwater monitoring plan which will be implemented concurrently with the selected remedy.

The State has suggested that the land use restrictions and remedy maintenance be specified and implemented in a manner that assures protection and long term stability of all cover materials. Details of the necessary land use restrictions and cover maintenance will be presented in the remedy Implementation Plan.

The State has expressed concern over the transport of dioxin to the Spring River during and subsequent to implementation of the selected remedy. Sampling and analysis of the Spring River fish and sediment will be conducted to monitor the short and long term effects associated with implementation of the selected remedy and continued on-site presence of dioxin in concentrations below the stated action levels. Details on efforts to prevent runoff of dioxin contaminated soils during implementation of the selected remedy will be provided in the Implementation Plan.

The State of Missouri has supported thermal destruction of dioxin-contaminated soils excavated from southwest Missouri dioxin sites at a central location. Support of this concept was advanced initially by former Missouri Governor Christopher Bond in a December 8, 1982 correspondence to the EPA Assistant Administrator for the Office of Solid Waste and Emergency Response. In this correspondence, the state requested that contaminated soils be excavated and that the possibility of incineration should be explored. The Governor, at that time, expressed willingness to provide the state's required ten percent cost share to assist in this effort.

On February 14, 1983, Governor Bond, by executive order, established a Governor's Task Force on Dioxin. The task force submitted its final report to the Governor on October 31, 1983, recommending that dioxin-contaminated soil at sites in Missouri be excavated and stored until a proven technology is available to assure a comprehensive and permanent solution to dioxin contamination with minimum risk to public health and the environment. The EPA believes that thermal treatment represents such a proven technology.

The State of Missouri has operated a test facility at Times Beach since 1984 which allows independent researchers to evaluate the effectiveness of dioxin destruction technologies in the field. To date, only thermal treatment technologies have demonstrated success at reducing contaminant levels in soils to the extent required for delisting and protection of human health.

The State of Missouri recently has reconfirmed its support of centralized thermal

treatment of dioxin-contaminated soils during negotiations concerning the final disposition of structures and debris at Times Beach, Minker/Stout/Romaine Creek and other eastern Missouri dioxin sites.

#### 4.0 THE SELECTED REMEDY

Based on the information available to evaluate the remedial options against the previously described criteria, EPA hereby conclude that excavation and thermal treatment of soils contaminated with dioxin above the 20 ppb action level is the Agency's preferred alternative. This alternative will be protective of human health and the environment as well as cost-effective. Additionally, because this alternative employs thermal destruction to eliminate the principal threat at the site, this option also satisfies SARA's preference for remedies which employ treatment as the principal element to reduce toxicity, mobility, or volume.

For those soils containing less than 20 ppb dioxin, the EPA hereby concludes, based on the criteria previously set forth that the in-place containment of these soils, under vegetative covers is the preferred alternative. This remedial action is both cost effective and protective of human health and the environment.

Although this remedy will require measures to control possible risks related to its implementation, the Agency's analysis indicates that all of these risks can be controlled satisfactorily. Additionally, any short-term risks are heavily outweighed by the long-term effectiveness and permanence this remedy will provide.

The remedy selected for implementation at the Syntex, Verona site is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (NCP); 40 CFR Part 300 *et. seq.*, 47 Federal Register 31180, July 16, 1982.

The selected remedy for dioxin-contaminated soils at the Syntex, Verona site consists of those actions listed in Table 4.1. Each of the subsites or waste units listed in the table are accompanied with its respective remedy. A more detailed description of each of the elements of the selected remedy follows the discussion of action levels.

#### 4.1 ACTION LEVELS

An action level of 20 ppb dioxin, based on the 95 percent confidence level for all areas of the Syntex, Verona site, is appropriate for the cleanup of dioxin-contaminated soils at the site; the areas which require cleanup to this level are the Burn Area, Irrigation Area and the Lagoon Area. Soils in these areas which contain concentrations of dioxin greater than the action level will be excavated and thermally treated to destroy the dioxin. The remaining areas of the site contaminated with dioxin at levels between 1 ppb and 20 ppb will have vegetative covers established and maintained to reduce the mobility of the dioxin. Surface concentrations will be determined at the 95 percent confidence level, using the procedure utilized during the cleanup of other Missouri dioxin sites. This procedure has been peer reviewed and approved by Federal and State health and environmental agencies.

Excavated soils will be transported by truck to the Denney Farm site

(approximately 15 miles away) for thermal treatment at the incinerator located at the Denney Farm, provided that Syntex executes an access agreement with the owner of Denney Farm. The incinerator will remove the dioxin from the soil and destroy the dioxin. The resulting ash will be disposed of at a state approved landfill. The resulting wastewater will be discharged under an approved state permit.

If Syntex is unsuccessful in its efforts to reach such an agreement for the purpose of incinerating these soils, the contaminated soil will remain onsite; soils will be excavated no later than one year after EPA approval of the Syntex Implementation Plan and stored onsite in accordance with the applicable EPA rules and regulations. Clean backfill material will be placed in the area of excavation, followed by six inches of topsoil, the surface of which will be graded for drainage. A vegetative cover will be established on the graded topsoil surface to complete the remedial action.

## 4.2 SUBSITE REMEDIAL ACTION

### 4.2.1 "Grid" Area

The average dioxin surface concentration in the "Grid" Area is 0.15 ppb; the highest concentration is 3.1 ppb. Maintenance of the existing vegetative cover to prevent erosion will provide adequate protection of the public health.

### 4.2.2 Burn Area

The average dioxin surface concentration in the Burn Area is 6.5 ppb; the highest concentration is 24 ppb at the surface and 27 ppb at depth. In order to provide a remedy which is protective of the public health, all soils containing 20 ppb or more dioxin based on the 95 percent confidence level sampling, will be excavated up to a four-foot depth, to bedrock or to a dioxin concentration less than the action level whichever occurs first. An estimated total of 30 cubic yards of contaminated soils will be excavated and incinerated as described, in Section 4.1.

### 4.2.3 Spill Area

The average dioxin surface concentration in the Spill Area is 2.0 ppb; the highest concentration is 4.8 ppb. Because this area has a 6-inch surface layer of gravel (underlain by a 10-mil polyethylene sheet) which will not support a vegetation cover, the gravel and polyethylene sheeting will be removed and the area will be backfilled with topsoil. The topsoil then will be reseeded with grasses to prevent erosion, thus protecting the public health. The excavated gravel will be used as backfill in other, more contaminated areas (such as the lagoon area).

### 4.2.4 Irrigation Area

The average dioxin surface contamination level in the Irrigation Area is approximately 4.0 ppb; the highest concentration is 29 ppb. In order to provide a remedy which is protective of the public health, all soils containing 20 ppb or more dioxin based on the 95 percent confidence level sampling will be excavated up to a four-foot depth, to bedrock or to a dioxin concentration less than the action level whichever occurs first. An estimated total of 30 cubic yards of

TABLE 4.1

## Selected Remedy for Syntex Verona

	AREA	REMEDY
a.	Grid Area	Maintain Vegetation
b.	Burn Area	Excavate soils >20 ppb, incinerate, dispose ash/residue as appropriate, backfill with clean material, and reestablish vegetation.
c.	Spill Area	Remove gravel, backfill with topsoil, and establish vegetation.
d.	Irrigation Area	Excavate soils >20 ppb, incinerate, dispose ash/residue as appropriate, backfill with clean material, and reestablish vegetation.
e.	Trench Area	Backfill, grade, provide a 12" cover and, establish and maintain vegetative cover. Establish subsurface monitoring of unsaturated and/or saturated zones. Five year review.
f.	Lagoon Area	Excavate soils >20 ppb, incinerate, dispose ash/residue as appropriate, backfill with clean material, and reestablish vegetation.
g.	Slough Area	Establish and maintain vegetation cover.
h.	NEPACCO Equip.	Clean, wipe test, and determine proper disposal or reuse conditions.
i.	Photolysis Equip.	Solvent rinse, acid rinse, water rinse, disassemble, inspect, wipe test, and determine proper disposal or reuse conditions.
j.	Groundwater	Groundwater monitoring/ remediation for the plant site and trench area will be addressed in a future operable unit.
k.	Solvents and Washes	Transport solvents to RCRA permitted facility for treatment and/or disposal (subject to land ban), treat aqueous washes.

contaminated soils will be excavated and incinerated as described above, in Section 4.1.

#### 4.2.5 Lagoon Area

The average dioxin surface contamination in the Lagoon Area is 279 ppb, the highest concentration is 1380 ppb, which exceeds the action level for industrial and nonresidential areas. In order to provide a remedy which is protective of the public health, all soils containing 20 ppb or more dioxin based on the 95 percent confidence level sampling at the subsite, will be excavated up to a four-foot depth, to bedrock or to a dioxin concentration less than the action level whichever occurs first. An estimated total of 800 cubic yards of contaminated soils will be excavated and incinerated as described above in Section 4.1.

#### 4.2.6 Slough Area

The average dioxin concentration in the Slough Area is 1.5 ppb, the highest concentration is 8.4 ppb. In order to provide a remedy which is protective of the public health, a vegetative cover will be established and maintained over all soils containing 1 ppb or more dioxin. This activity would involve placing clay in the Slough channel as a backfill material and grading the surface to produce a gradual swale. Six inches of topsoil would then be added to support a vegetative cover.

#### 4.2.7 Trench Area

The average dioxin concentration in the Trench Area is less than 17.3 ppb; the highest concentration is 67 ppb. These samples were composited from the surface to a depth of 9 to 12 feet. Unlike the other subsites which lie in the floodplain, the Trench Area is underlain by a substantial layer of low permeability soils, predominantly clay. Borings beneath the Trench Area have revealed nondetectable levels of dioxin. Excavation of the Trench Area may result in migration of contaminants located there as the excavation activities could disrupt the low permeability layers beneath the subsite. For this reason, remediation of the Trench Area, under this operable unit, will include: backfilling trench depressions to original grade with gravel aggregate; installation of a 12 inch clay layer that will extend ten feet beyond trench boundaries; and subsequent installation of 12 inches of topsoil to support a vegetative cover. In addition, a gravel, drainage-interception trench will be installed upgradient of the trench area. A five year review will be conducted at the Trench Area because contamination will remain above health-based criteria. This review will assure effectiveness of the remedy in the Trench Area. Additional subsurface monitoring, described in Section 4.2.11, will be implemented concurrently with this remedial action. If monitoring reveals contamination of the groundwater in this area at levels of concern, additional remedial action will be implemented through an additional operable unit.

#### 4.2.8 Old NEPACCO Equipment

This waste unit comprises process equipment at the Syntex, Verona site which is contaminated and requires remedial action. Some of the equipment was cleaned but still has detectable dioxin surface contamination. The contaminated equipment will be cleaned using an acid wash followed by detergent and solvent washes. Equipment cleaned to less than 10 ng/m<sup>2</sup> may be released for reuse.

while equipment still contaminated to greater than 10 ng/m<sup>2</sup> must be disposed in accordance with RCRA requirements. Treatment and disposal of the solvents and wash solutions is discussed below. This remedy will protect the public health and the environment.

#### 4.2.9 Photolysis System

The photolysis equipment used to degrade dioxin in the still bottom wastes from tank T-1 will be decontaminated using solvent and aqueous washes. After washing, the equipment will be completely dismantled and inspected. If wipe tests indicate surface contamination less than 10 ng/m<sup>2</sup> the equipment may be released for reuse. Otherwise, the equipment will be disposed in accordance with RCRA requirements.

#### 4.2.10 Solvents/Washes

All solvents used during the remedial activities will be collected and shipped for treatment and/or disposal at a RCRA permitted facility. Aqueous washes from equipment cleaning processes will be treated to remove dioxin, using a proprietary Syntex process. The effluent water from the treatment process having a dioxin concentration of less than 1 ppt will be treated by evaporation. Any filter cake or carbon materials generated by the treatment process will be transported to a RCRA-permitted facility for treatment and/or disposal.

#### 4.2.11 Groundwater

Activities under this first operable unit will not include remediation of the local groundwater as the EPA at this time does not have sufficient data on which to determine groundwater remediation needs. Efforts to assess and monitor the local and area groundwaters will be initiated concurrently with implementation of this plan. If data generated from this monitoring shows contamination of the groundwater at levels of concern, remediation of the groundwater will be conducted through a second operable unit. This assessment and monitoring effort will include the installation of groundwater monitoring well clusters in the Trench Area and upgradient and downgradient of the plant site.

#### 4.2.12 Spring River

Efforts to monitor Spring River fish and sediment will continue as specified in the Syntex, Verona Fish and Sediment Sampling Plan. As with the groundwater, if data generated during the monitoring activities reveals contamination at levels of concern, remediation of the Spring River will be conducted through an additional operable unit.

### 4.3 REMEDY SUMMARY

The remedy selected under the first operable unit for the Syntex, Verona site will address only the dioxin-contaminated soils, equipment and debris at the facility. Spring River and local groundwater remediation at the plant site and in the Trench Area, if determined to be necessary by the EPA, will be addressed in a second operable unit. The selected remedy represents a combination source-control and stabilization measure for dioxin-contaminated materials at the site. A five year review will be conducted at the Trench Area because contamination will remain above health-based criteria. This review will assure effectiveness of

the remedy in the Trench Area.

A site-specific action level of 20 ppb has been established as an appropriate cleanup level for Syntex, Verona. This action level will result in the excavation of approximately 860 cubic yards of dioxin-contaminated soil from Syntex, Verona which will be transported and treated thermally at the Denney Farm incinerator or stored onsite in accordance with applicable EPA rules and regulations. The thermal treatment process utilized in the treatment of excavated soils will result in the removal of dioxin from the soil and destruction of the dioxin. The residue ash from the treatment will be proposed for delisting and disposed as a solid waste at an approved location. Following implementation of the described action, access restrictions will be maintained at the site.

## 5.0 STATUTORY DETERMINATION

Based upon available information, the selected remedy satisfies the remedy selection requirements under CERCLA, as amended and the National Contingency Plan. The selected remedy at the site is protective of public health and the environment, satisfied all identified applicable or relevant and appropriate environmental requirements and is cost-effective. Federal and state health officials have determined that removing all soils exceeding 20 ppb dioxin in industrial or nonresidential areas, and establishing and maintaining vegetation covers over all soils containing less than 20 ppb dioxin at the Syntex, Verona site will adequately achieve protection of public health.

The selected remedy under the first operable unit at the Syntex, Verona site provides protection of the environment by preventing the mobilization of dioxin-contaminated soils by erosion and by removing and treating soils contaminated in excess of the 20 ppb action level. Erosion is prevented in soils having dioxin concentrations below the action level either by maintaining existing vegetative covers or by establishing new vegetative covers. On the basis of existing data, the Syntex, Verona site is not a significant source of dioxin to the Spring River. The vegetative covers will ensure that the potential for transport of dioxin into the Spring River is no more than the existing non-detectable rate and that the direct contact exposure pathway is controlled for area wildlife. Prior investigations have detected no release of dioxin through airborne or groundwater pathways.

The estimated costs of the entire project potentially includes costs of excavation, transportation, treatment, providing soil backfill and vegetative covers, cover maintenance and verification sampling. Costs of the remedy largely depend on the volume of soils excavated and costs of thermal treatment. The potential total costs for cleanup of the site is approximately \$5.62 million. Inclusion of the soil volumes excavated from the Syntex, Verona site in the other total volumes estimated for transport to the Incinerator Unit at Denney Farm will promote considerable cost savings.

The thermal treatment alternative presented in this document for soils containing more than 20 ppb is the only implementable alternative identified which is protective and attain federal and state environmental and public health requirements. The thermal treatment alternative also satisfies the statutory preference under SARA for remedies which reduce the toxicity, mobility, or volume of hazardous waste and utilize alternative treatment technologies to the maximum extent practicable.